C4

21. (Amended) The thin sheet as claimed in Claim ~~14~~ 7, wherein the plane anisotropy coefficient is 0.08-0.12.

Cancel Claims 18 and 22.

REMARKS

Claim 8 has been amended to recite the percentage of aluminum at most 0.010. Basis for this amendment appears on page 7, lines 4-7 of the specification. The step of annealing is recited to be carried out at a temperature between 640°C and 670°C. Basis for the lower point of the range of 640°C is found on page 15, lines 11-15. Basis for intermediate points in the range are found on page 12, lines 3-5 in which a temperature of 650°C is set forth for annealing, page 20, lines 37 through page 21, line 2 in which a temperature of annealing is stated to be about 650°C or slightly higher and basis for the upper end of the range of 670°C is found on page 12, lines 13-15 and page 13, Table 3, where steels of the invention M825, R2116A and R2115A, show an annealing temperature of 670°C. Claim 9 is amended to recite the annealing temperature range of Claim 8 above, Claim 11 is amended to put the annealing temperature at 670°C. Claim 14 is amended to be recited in terms of product by process with the limitation on aluminum, titanium and niobium being set forth as amended in Claim 8. Claim 20 is amended to recite the aluminum limitation as set forth in Claim 8, the annealing temperature range as set forth in Claim 8 and adds the limitations on titanium, niobium and the Lankford coefficient as set forth in Claim 8. Finally, Claim 21 has been amended to change "plain" to "plane". Basis for this amendment may be found on page 14, lines 21-23 of the application. No new matter has been added by these amendments.

REQUEST FOR RECONSIDERATION

The Examiner has rejected Claims 8-23 under 35 U.S.C. §103(a) as being unpatentable over European Patent 556834 for reasons set forth in the Office Action of paper 18. The Examiner states that EP '834 on page 8, lines 1-10 discloses a coiling temperature of 400 to 600°C, which overlaps with the coiling temperature range of the instant claims and notes that there is no comparative test data to show the coiling temperature range of the claims is critical and produces new and unexpected results. The Examiner states that other parameters such as r value and the ranges for titanium and niobium may be overlapped by EP '834 and that the anisotropy coefficient would be inherent in the absence of proof to the contrary.

It is Applicants' position that the claims, as now amended, distinguish over European Patent 556834 for the following reasons. Claim 8 has been amended to recite the percentage of aluminum of at most 0.010 and that the step of continuously annealing the intermediate cold-rolled sheet is at a temperature of between 640°C and 670°C. The limitation on annealing temperature in conjunction with the coiling temperature range for the hot-rolled sheet of between greater than 530°C to 570°C distinguishes over the process of the European patent, because the combination of the annealing temperature range and the coiling temperature range is not shown in the European patent. All of the Examples in Table 3 of EP '834 except Sample No. 3 show an annealing temperature of 700°C or higher. In Sample 3, however, the coiling temperature is at 520°C, lower than the lowest point by more than 10°C of the coiling temperature of Claim 8. Further, in Samples 10, 11, 13, 14, 16 and 18, which show a coiling temperature of greater than 530°C, the upper limit of the coiling temperature of 570°C is exceeded in Samples 10 and 13 and in all of the above-mentioned Samples the annealing temperature is higher than the upper limit on the annealing

temperature of Claim 8 of 670°C. The annealing temperatures of the above-mentioned Samples run from a low 700°C to a high of 760°C. Thus, it can be seen that Claim 8, as amended, and other process claims dependent thereon distinguish over what is shown in the European patent.

Further, the process as discussed above produces a sheet of steel as set forth in Claims 14 and 21, which sheet is now defined as being made by the process of Claim 8 and is distinguished from the sheets made in the European patent by data in the specification. The steel sheet in Claim 14 now contains the limitation of at most 0.010% aluminum and at most 0.001% titanium and 0.001% niobium. As stated on page 9, lines 8-11, in order to obtain suitable sheet recrystallization conditions, the titanium content is limited to 10 ppm at most and the niobium content is also limited to 10 ppm at most. Attached to the Response is a diagram showing the temperature of the end of recrystallization of steel sheets elaborated according to the process of the invention, having different titanium contents. Figure 1 and the discussion on page 15 of the specification is directed to the investigation of the recrystallization conditions and the temperature at which recrystallization of the steels on Table 3 take place. The first three steels on Table 3 are the steels of the invention as shown on Table 1 on page 6 of the specification. It can be seen from Figure 1 that the steels of the invention all reach 100% crystallization at about 640°C, while the sheets outside the invention all show higher recrystallization temperatures. Thus, it can be seen that the steels of the instant claims exhibit lower temperatures of complete recrystallization than steels outside the parameters of the instant claims.

Figures 2A through 2E, discussed on page 15, lines 36 through page 16, show that the steel sheets of Figures 2A and 2B, sheets according to the instant invention, show grains of a homogeneous size and equiaxed structure, while sheets of Figures 2C through 2E, outside the

invention, show a grain structure of nonhomogeneous size, nonequiaxed structure and an irregular and elongate structure known by the name "pancake" structure. Thus, it can be seen that the steels of the instant claims produce a grain structure which is more homogeneous and of an equiaxed structure than steels outside the parameters of the claims.

In Figures 5A through 5C and Figure 6, which are discussed on pages 17 and 18 of the specification show various Lankford coefficients and a Lankford average coefficient, which coefficient is indicative of high standard anisotropy conducive to drawing of the steel. Figures 5A through 5C are Lankford coefficients in a longitudinal direction, the transverse direction and at 45°. Figure 6 shows the average Lankford coefficient for the entire sheet as a function of the aluminum content. Above ten thousandths of a percent aluminum the average Lankford coefficient very rapidly falls below 1.6 before stabilizing at around 1.45 in the case of the highest aluminum contents of the sheet specimens on which the tests were carried out. This indicates that steels with aluminum amounts higher than the amounts of the instant claims, will not produce steels with an average Lankford coefficient greater than 1.6.

Table 4 on page 18 of the specification gives compositions, coiling and annealing temperatures and other parameters for steels A through L, of which only steel C corresponds to the instant invention. The steels either exhibit aluminum contents greater than ten thousandths of a percent, carbon content outside the range of the instant claims or both aluminum content and carbon content outside the range of the claims. In addition some of the sheets show a coiling temperature higher than that of the instant invention. As discussed on pages 19 through page 23, line 6, the steels of Table 4 which are outside the parameters of the instant claims show an inferior structural homogeneity and more inclusions than the steels of the instant invention. In comparing the sheet of the invention C with sheet J, which is coiled at a temperature above the range of the instant invention it can be seen as discussed on

page 19, lines 25-37, that the grain index GI of the sheet J is less than the grain index of the sheet C and less than 10, indicating that C has a finer grain structure than J.

The steels used in the context of the instant invention are steels substantially free of titanium and niobium, the contents of these elements being limited to 10 ppm, i.e., 0.001% by weight. This is because with titanium content and niobium content above these limits, it would be impossible to conduct annealing and have 100% recrystallization between 640°C and 670°C, as discussed on page 23, lines 13-16 of the specification.

Finally, the sheets obtained by the process according to the instant invention which have a carbon content of at most six thousandths of a percent and an aluminum content of at most ten thousandths of a percent have, after the final cold rolling, a homogeneous microstructure containing equiaxed grains and very good drawability characteristics as clearly indicated in Figures 2A and 2B of the invention which were compared to 2C through 2E, outside the invention, above. The microstructure of the sheet of the invention is homogeneous in the transverse direction and the edges of the sheet have homogenous equiaxed grains, the size of which is slightly greater than the size of the grains in that part of the strip near the axis. In addition, inclusion cleanliness, which is a characteristic of the sheets of the instant invention, is of great value in the case of use of very thin sheets for the manufacture of metal packages, such as drink cans by drawing. Thus, it can be seen that the process claims distinguish over what is shown in the European patent and the process produces a steel sheet which exhibits unexpected results as compared to steel sheets outside the parameters of the instant claims.

It is submitted that Claims 8-17, 19-21 and 23 are allowable and such action is respectfully requested.

Respectfully submitted,

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Marked-Up Copy
Serial No: 09/129,238
Amendment Filed on:
May 9, 2001

IN THE CLAIMS

--8. (Twice Amended) Process for producing a thin sheet of ultra-low-carbon steel, said process comprising:

-producing a killed and vacuum-degassed steel comprising, by weight, between 0.10 and 0.35% manganese, less than 0.006% nitrogen, less than 0.025% phosphorus, less than 0.020% sulphur, less than 0.020% silicon, a total amount of the elements copper, nickel and chromium of at most 0.08%, at most 0.006% carbon and at most [0.020] 0.010% aluminum, iron and inevitable impurities,

-casting the steel in the form of a slab,

-hot-rolling the slab at a temperature above Ar3 to obtain a strip of hot-rolled sheet,

-coiling the hot-rolled sheet,

-cold-rolling the hot-rolled sheet into the form of an intermediate cold-rolled sheet,

continuously annealing the intermediate cold-rolled sheet at a temperature [below Ac1] between 640°C and 670°C,

rerolling the intermediate cold-rolled sheet down to a final sheet thickness for drawing,

wherein said hot-rolled sheet is coiled at a temperature between greater than 530°C to 570°C, and wherein said process provides a sheet of ultra-low-carbon steel comprising at

most 0.001% titanium and at most 0.001% niobium and having a Lankford coefficient r_{aver} greater than 1.6.

9. (Amended) Process according to Claim 8, wherein the steel comprises at most 0.001% titanium by weight and at most 0.001% niobium by weight and wherein the cold-rolled sheet is annealed at a temperature [below 700°C] between 640°C and 670°C for a time of less than 3 minutes.

11. (Amended) Process according to Claim 9, wherein the hot-rolled sheet has a thickness of about 3 mm, the hot-rolled sheet is cold rolled with a reduction ratio of 90 to 93%, the intermediate cold-rolled sheet is continuously annealed at a temperature of [about] 670°C for a time of about thirty seconds and, after annealing, the intermediate sheet is rerolled in a skin-pass rolling mill with a reduction ratio of between 2.5 and 17%.

14. (Amended) A thin sheet of ultra-low-carbon steel made by the process of Claim 8[,] comprising, by weight, between 0.10 and 0.35% manganese, less than 0.006% nitrogen, less than 0.025% phosphorus, less than 0.020% sulphur, less than 0.020% silicon, a total amount of the elements copper, nickel and chromium of at most 0.08%, at most 0.006% carbon and at most [0.020] 0.010% aluminum, iron and inevitable impurities, [the thin sheet being obtained by cold rolling a hot-rolled sheet by a first rolling operation and by a second rolling operation separated by a continuous annealing operation,] wherein it has a homogeneous structure with equiaxed grains, [and it has] a Lankford coefficient (r_{aver}) greater than 1.6 and a plane anisotropy coefficient (ΔC) close to 0, and wherein said sheet comprises at most 0.001% titanium and 0.001% niobium.

20. (Amended) Process for producing a thin sheet of ultra-low-carbon steel, said process comprising:

-producing a killed and vacuum-degassed steel comprising, by weight, between 0.10 and 0.35% manganese, less than 0.006% nitrogen, less than 0.025% phosphorus, less than 0.020% sulphur, less than 0.020% silicon, a total amount of the elements copper, nickel and chromium of at most 0.08%, at most 0.006% carbon and at most [0.020] 0.010% aluminum, iron and inevitable impurities,

-casting the steel in the form of a slab,

-hot-rolling the slab at a temperature above Ar3 to obtain a strip of hot-rolled sheet,

-coiling the hot-rolled sheet,

-cold-rolling the hot-rolled sheet into the form of an intermediate cold-rolled sheet,

continuously annealing the intermediate cold-rolled sheet at a temperature [below Ac1] between 640°C and 670°C,

rerolling the intermediate cold-rolled sheet down to a final sheet thickness for drawing,

wherein said hot-rolled sheet is coiled at a temperature between greater than 530°C to 570°C, and wherein said process provides a sheet of ultra-low-carbon steel comprising at most 0.001% titanium and at most 0.001% niobium and having a Lankford coefficient r_{aver} greater than 1.6.

21. (Amended) The thin sheet as claimed in Claim 14, wherein the [plain] plane anisotropy coefficient is 0.08-0.12.--

Claims 18 and 22 (Canceled).

LEDEPP/ CRFB	**Influence de la teneur en Ti sur la température de recristallisation et ΔCaniso de l'acier ULC calmé Al**	Planche 1 15297/96

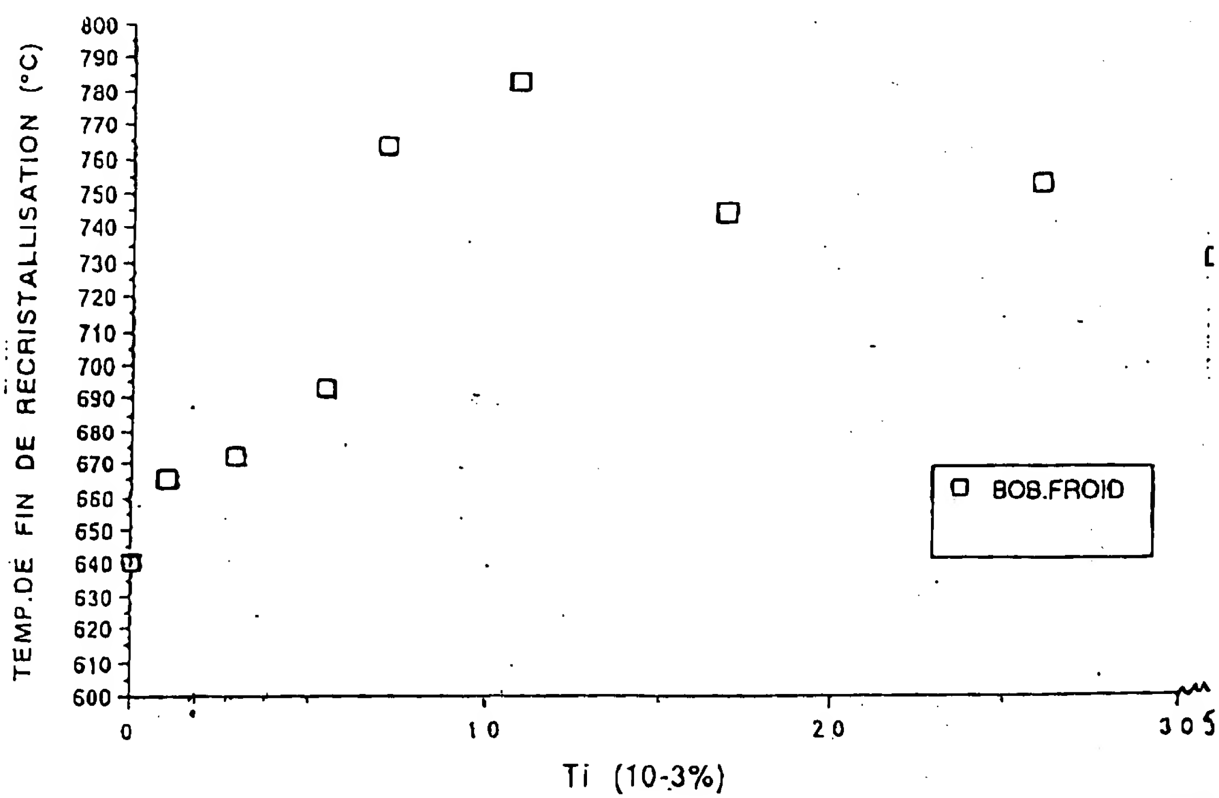

figure 1